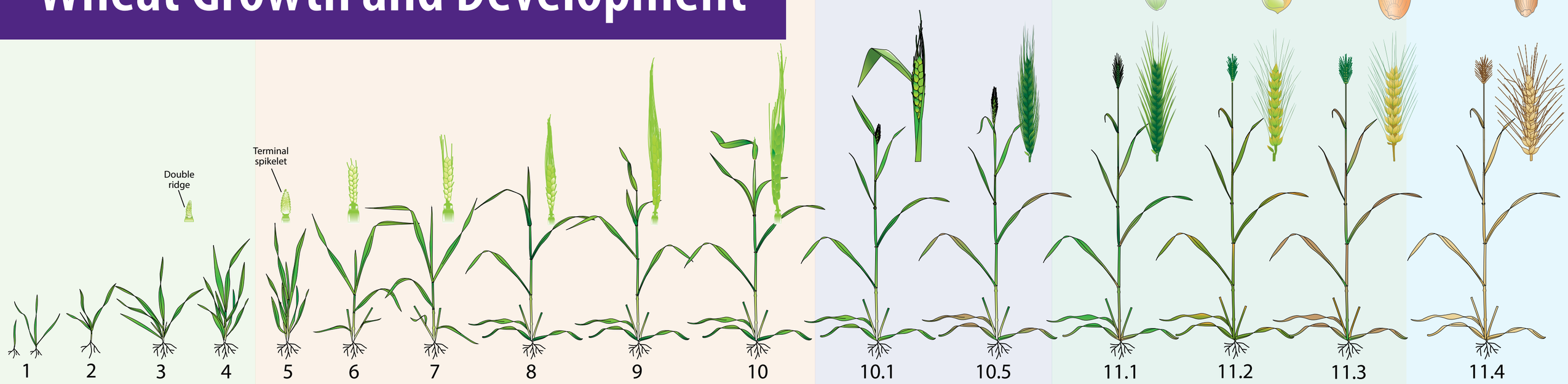
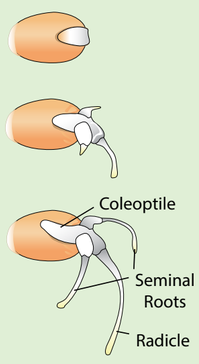
Wheat Growth and Development



Feekes Scale of Wheat Development

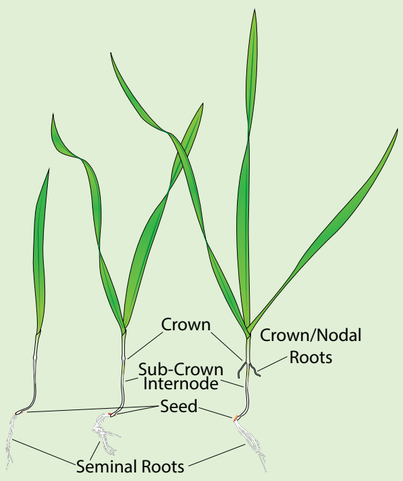
Leaf and Tiller Development | Stem Elongation | Heading and Flowering | Grain Filling | Ripening

Leaf and Tiller Development



Germination. Seeds absorb water and oxygen. The radicle, seminal roots, and the coleoptile (leaflike structure enclosing the first true leaf) emerge from the seed. Temperatures between 54 and 77 degrees Fahrenheit are optimal for germination.

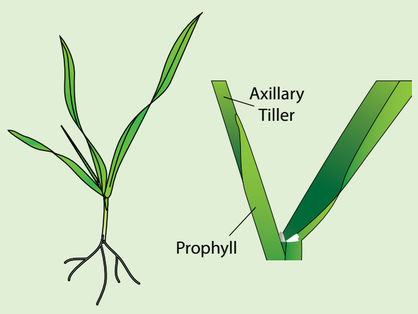
Management. Use certified seed or ensure good seed cleaning and sizing. Fungicide and insecticide seed treatments can help manage early-season diseases and insect pests. Soil test and ensure 30 to 40 pounds of nitrogen per acre are available for fall growth. In dual-purpose systems, ensure 40 pounds of nitrogen per acre are available per 1,000 pounds per acre of forage goal.



Feekes 1

Emergence. Emerging from the soil, the coleoptile stops growing when it senses light. The first true leaf emerges through the tip of the coleoptile. Three leaves fully develop before tillering initiation. The seminal rooting system expands. The crown forms between the seed and soil surface.

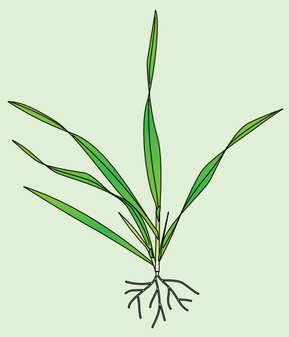
Management. Scout for proper emergence with a targeted stand of 15 to 25 plants per square foot, depending on annual precipitation. Monitor fields for fall armyworm and other early-season pests.



Feekes 2

Tillering initiation. Tillers are initially encased in a protective structure called the prophyll. If there are three leaves visible, a tiller will be at the base of the first leaf. Fall-formed tillers contribute more to grain yield than spring-formed tillers. The crown root system starts to develop.

Management. In dual-purpose systems, start grazing only after establishment of crown roots, which anchor plants in the soil.



Feekes 3

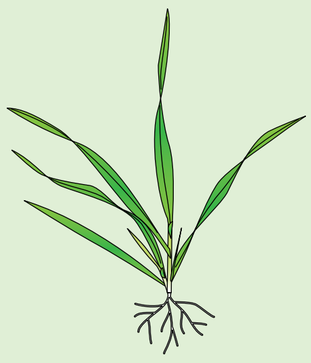
Continued tillering. Primary tillers develop in the axils of the first four or more true leaves of the main stem. Secondary tillers may develop from the base of primary tillers. Tiller development is prioritized based on their sequential formation. The development of the crown root system increases extensively. From 5 to 15 percent of the total dry matter is accumulated by this stage, depending on sowing date, seeding rate, fertility, fall temperatures, and moisture availability.

Management. Scout for insect pests and weeds. Fall herbicide applications generally provide better control, reducing weed competition.

Winter dormancy

Vernalization. Gradually lowering temperatures and shortening day length induce winter hardiness in winter wheat. Vernalization requirements range from three to eight weeks of temperatures below 50 degrees Fahrenheit.

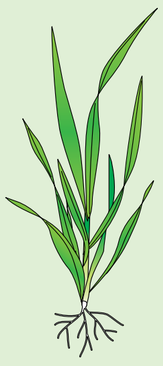
Management. Manage stocking density in dual-purpose wheat systems and try to maintain 60 percent canopy coverage.



Feekes 3

Completion of tillering. Once requirements are met, the growing point differentiates and the embryonic head reaches the double ridge stage. Depending on the season and planting date, some tillering occurs in the spring. Genetic potential and environmental conditions determine the number of tillers on a plant. Tillers with three or more leaves are nutritionally independent from the main stem.

Management. If fewer than 70 tillers per square foot are present, an early nitrogen application can increase spring tillering and help compensate for thin stands.

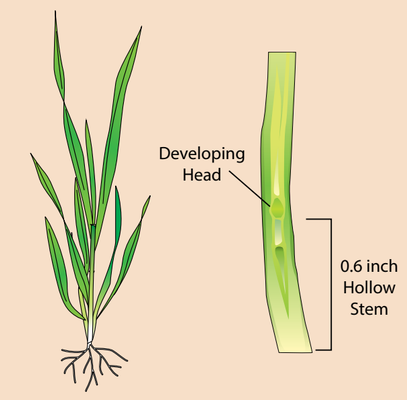


Feekes 4

Leaf sheaths lengthen (spring greenup). Leaf sheaths begin to lengthen. The pseudo-stem, a succession of leaf sheaths wrapped around each other, starts to become erect.

Management. Ideal time to make single spring nitrogen applications based on yield goal. Scout for insects and weeds.

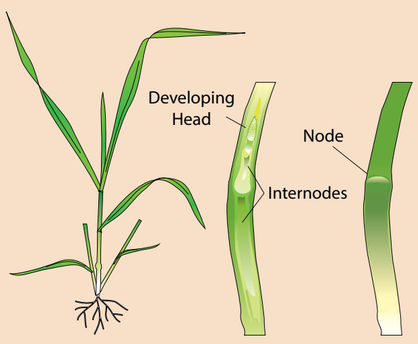
Stem Elongation



Feekes 5

Leaf sheaths strongly erect. The pseudo-stem is strongly erect and leaf sheaths are elongated. The developing head reaches the terminal spikelet stage and is pushed up into the pseudo-stem. The potential number of spikelets per head is determined at Feekes 5. The first hollow stem stage occurs when there is approximately 0.6 inch of hollow stem below the developing head. Crop water use is about 0.1 inch per day.

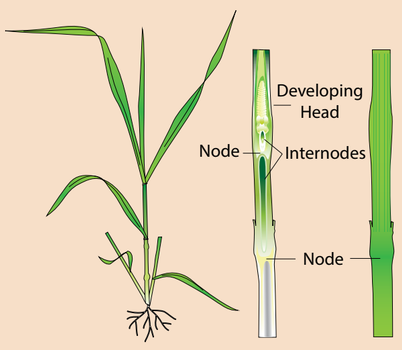
Management. Ideal time for second nitrogen application if split applying in the spring. Cattle should be removed from dual-purpose wheat before first hollow stem.



Feekes 6

First node of stem visible (jointing). The first node of the stem becomes visible as a result of internode elongation. Nodes are stacked and move up as the internodes elongate much like a telescope. Sensitivity to low temperatures increases as the developing head is pushed up by the expanding stem. Crop water demand increases to about 0.25 inch per day. Approximately 25 percent of the total dry matter is accumulated by this stage.

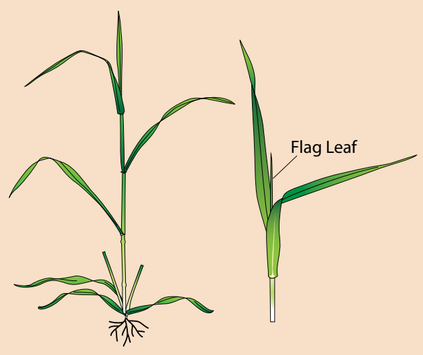
Management. Consider a first fungicide application under significant disease pressure. Do not apply dicamba or 2,4-D after wheat reaches jointing, and avoid equipment with wide tires.



Feekes 7

Second node of stem visible. As the second node of the stem becomes visible, the next-to-last leaf is just visible. Demand for water and nutrients increases. Temperatures lower than 24 degrees Fahrenheit can damage the developing head.

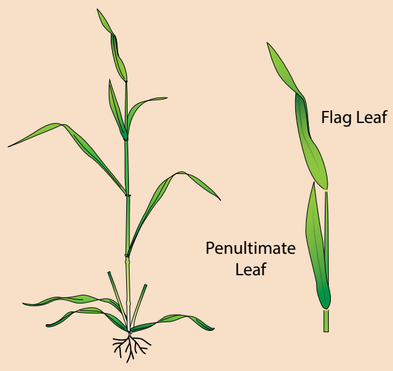
Management. Plant growth regulators may be applied at this growth stage. Scout for insects, weeds, and diseases.



Feekes 8

Last leaf just visible. The flag leaf starts to emerge from the whorl above the third or fourth node. Strong partitioning of photosynthates to the developing head. Crop water demand increases to about 0.3 inch per day. Approximately 45 percent of the total dry matter is accumulated by this stage.

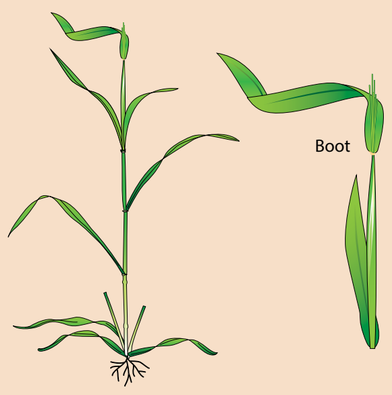
Management. To maintain optimal leaf area, scout for diseases and pests.



Feekes 9

Ligule of flag leaf visible. The flag leaf is completely emerged from the whorl. Flag leaf and the next-to-last leaf (penultimate leaf) combined account for 70 to 90 percent of the photosynthates used for grain fill and must be protected for the plant to develop to its full potential.

Management. Scout for insects and diseases. Consider a fungicide application to protect the flag leaf if foliar diseases are present on the lower canopy. Nitrogen application can increase grain protein levels.



Feekes 10

Boot. The head is inside the leaf sheath giving it a swollen appearance. The flag leaf sheath and peduncle elongate and the developing head is pushed through the flag leaf sheath. Temperatures below 28 degrees Fahrenheit may cause damage to the developing head.

Management. Scout for insects, weeds, and diseases. Application of 2,4-D after wheat reaches the boot stage of growth can result in trapped heads, missing florets, or twisted awns.

Head Development

Feekes 3 through 9

Double ridge. The primordia, which differentiate into spikelets, become visible after vernalization requirements are met. Floret initiation starts slightly above the middle portion of the microscopic head and moves outward. The number of florets initiated determines the potential number of kernels per head.

Terminal spikelet. This stage marks the completion of the spikelet initiation phase. At this stage, the number of spikelets per head has been determined. Terminal spikelet occurs at Feekes 5.

Head growth. Rapid head growth occurs in parallel with stem elongation during Feekes growth stages 6 through 9. Florets become ready for pollination and fertilization.

Head emergence. Tiller development synchronizes with the main stem, so flowering occurs almost simultaneously in the main stem and tillers, regardless of differences in tiller initiation.

Heading and Flowering

Head Emergence and Flowering

Feekes 10.1-10.5

Heading. The first heads escape through a split in the flag leaf sheath at Feekes 10.1. All heads are out of the sheath at Feekes 10.5. It usually takes 3 to 5 days for the head to fully extend above the flag leaf. Temperatures below 30 degrees Fahrenheit may damage the developing head. Crop water demand can exceed 0.3 inch per day during heading through the soft dough stage.

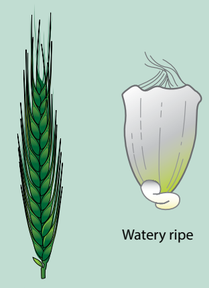
Management. Scout for insects, weeds, and diseases. A fungicide application may be considered to protect heads from scab. Check fungicide label for pre harvest interval restrictions.

Feekes 10.5.1-10.5.3

Flowering (anthesis). Flowering begins shortly after the head has fully emerged and lasts 3 to 5 days, starting slightly above the middle portion of the head. Feekes 10.5.2 occurs when flowering is complete at the top of the head and Feekes 10.5.3 occurs when flowering is complete at the base. The number of flowers pollinated determines the number of kernels per head. At this stage, wheat is extremely susceptible to freeze injury at temperatures below 32 degrees Fahrenheit. Approximately 75 percent of the total dry matter is accumulated by this stage.

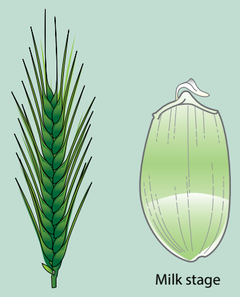
Management. Scout for insects, weeds, and diseases. Make note of weed escapes for future years. Attend variety tours and identify new varieties for your operation.

Grain Filling



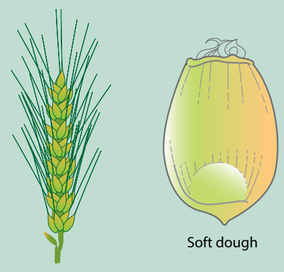
Feekes 10.5.4

Watery ripe. Establishment of kernel length about 10 days after flowering. Rapid increase in grain size, but little dry matter accumulation. A clear fluid can be squeezed from the developing kernel.



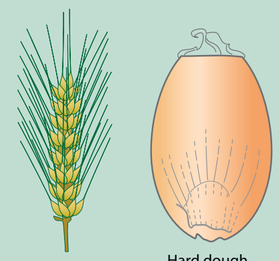
Feekes 11.1

Milky ripe (milk stage). Increase in solids content in the endosperm from photosynthates. This stage occurs 15 to 18 days after flowering. A milklike fluid can be squeezed out of the kernels when crushed between fingers.



Feekes 11.2

Mealy ripe (soft dough). During the dough stage, the kernel rapidly accumulates starch and nutrients and most of its dry weight. Material squeezed out of the kernel has a doughy consistency. Green color begins to fade and kernels are soft but dry. Maximum dry matter accumulation (100 percent) by the end of this stage.

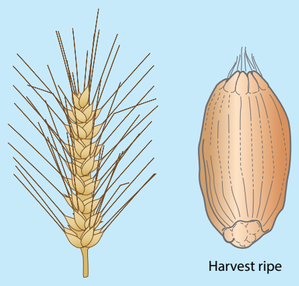


Feekes 11.3

Kernel hard (hard dough). Kernel moisture decreases from 40 to 30 percent during ripening. Kernels achieve maximum dry weight and are physiologically mature. Kernels are hard and difficult to divide with thumbnail.

Management. Monitor the crop for head scab and adjust yield predictions and marketing plans if present. Scout for wheat head armyworm. Severe heat or water stresses can reduce grain test weight.

Ripening



Feekes 11.4

Kernel ripe. Kernel moisture decreases from 30 to 15 percent during ripening, and green plant tissue becomes straw.

Management. Harvest as soon as grain moisture reaches 15 percent to avoid losses in test weight and grain quality. Check for head diseases that could require extra cleaning or seed treatment if saving the wheat for seed.

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